The United States has ratified this STANAG and it is approved for use. Actual promulgation by NATO is expected within one year. At that time, this document will be replaced by the promulgated version. Any U.S. comments or reservations are included in the following letter.

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

October 31, 2002

MEMORANDUM FOR U.S. MISSION TO NATO, ARMAMENTS COOPERATION DIVISION (ARMY ARMAMENTS OFFICER), PSC 81, APO AE 09724

SUBJECT: Draft STANAG 4526 (EDITION 1) – "SHAPED CHARGE JET, MUNITION TEST PROCEDURES "

Reference document, AC/310-D/198, 7 Mar 2002, SAB.

The U.S. Armed Forces ratifies the referenced agreement.

Ratification and implementation details are as follows:

	IMPLEMENTATION				
	Forecast Date			Actual Date	
RATIFICATION REFERENCE	NAVY	ARMY	AIR FORCE	NAVY	ARMY	AIR FORCE
Memo, OUSD(A&T) DATED AS ABOVE	October 31, 2002			October 31, 2002		

NATIONAL IMPLEMENTING DOCUMENT: None, STANAG is self-implementing.

RESERVATIONS: None

COMMENTS: None

The point of contact is Mr. James E. Elliott, DSN 880-3047, commercial (973) 724-3047.

Anthony J. Melita
U.S. Key Delegate
AC/310 Main Group

SUBJECT: Draft STANAG 4526 (EDITION 1) – "SHAPED CHARGE JET, MUNITION TEST PROCEDURES "

CF:

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NORTH ATLANTIC COUNCIL
CONSEIL DE L'ATLANTIQUE NORD

NATO/PfP UNCLASSIFIED

7 March 2002

DOCUMENT
AC/310-D/198

**GROUP ON SAFETY AND SUITABILITY FOR SERVICE (S3)
OF MUNITIONS AND EXPLOSIVES (AC/310)**

CNAD PARTNERSHIP GROUP (CPG)

RATIFICATION DRAFT 1 - STANAG 4526 (EDITION 1) SHAPED CHARGE JET, MUNITIONS TEST PROCEDURE

Memorandum by the Assistant Secretary General for Defence Support

(RATIFICATION REQUEST)

Reference: PfP(CPG-S/3-SG/3)DS/8 dated 30 November 2001

1. The Group on Safety and Suitability for Service of Munitions and Explosives, Sub-Group 3, approved, at reference, draft STANAG 4526 (Edition 1) for issue for ratification.

2. In line with the decision of the Group, the agreed text is herewith forwarded to delegations of NATO nations who are requested to obtain the national ratification by 1 October 2002. The delegations are asked to inform the Defence Support Division of their national Ratification references, together with a statement of the date by which national implementation is intended to be effective, using the ratification response form at Annex. The service or services within which the standard applies should be indicated.

3. Most national Ministries of Defence contain a standardization office or standardization liaison officer who can give advice on the procedure to be adopted to obtain a formal ratification reference. It is recommended that contact be made with that office.

4. As soon as sufficient ratifications have been received, this STANAG will be forwarded for promulgation.

(Signed) R. G. BELL

Enclosure: 1 Annex
Stanag 4526 (Edition 1)

Action Officer: R. Sladden
Original: English
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ANNEX to
AC/310-D/198

STANAG 4526
(Edition 1)
(Ratification Draft 1)

NATIONAL REPLY ON THE RATIFICATION AND IMPLEMENTATION OF A STANAG

(National Reference and Date)

To : Assistant Secretary General for Defence Support
NATO/OTAN

Subject : STANAG 4526 (Edition 1) - RATIFICATION DRAFT 1 – SHAPED CHARGE JET, MUNITIONS TEST PROCEDURE

Reference : AC/310-D/198 dated 7 March 2002

1. (*nation*) ratifies/does not ratify(*) the agreement received under cover reference.

2. Ratification and implementation details are as follows:

RATIFICATION REFERENCE AND DATE	IMPLEMENTATION					
	Forecast Date			Actual Date		
	NAVY	ARMY	AIR	NAVY	ARMY	AIR

3. NATIONAL IMPLEMENTING DOCUMENT(s):

4. RESERVATIONS:

5. OTHER INFORMATION:

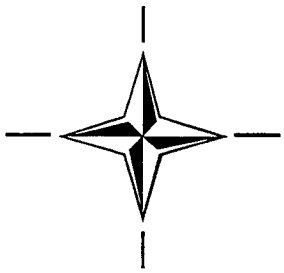
.....
(Signature block)

(*) Delete as appropriate

Enclosure to
AC/310-D/198

STANAG 4526
(Edition 1)
(Ratification Draft 1)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)



NATO STANDARDIZATION AGENCY
(NSA)

STANDARDIZATION AGREEMENT
(STANAG)

SUBJECT: SHAPED CHARGE JET, MUNITIONS TEST PROCEDURE

Promulgated on 2002

Jan H ERIKSEN
Rear Admiral, NONA
Director, NSA

Enclosure to
AC/310-D/198

STANAG 4526
(Edition 1)
(Ratification Draft 1)

RECORD OF AMENDMENTS

No.	Reference/date of amendment	Date entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Director, NSA under the authority vested in him by the NATO Military Committee.

2. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

4. Ratification is "In NATO Standardization, the fulfilment by which a member nation formally accepts, with or without reservation, the content of a Standardization Agreement" (AAP-6).

5. Implementation is "In NATO Standardization, the fulfilment by a member nation of its obligations as specified in a Standardization Agreement" (AAP-6).

6. Reservation is "In NATO Standardization, the stated qualification by a member nation that describes the part of a Standardization Agreement that it will not implement or will implement only with limitations" (AAP-6).

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

7. Page (iii) gives the details of ratification and implementation of this agreement. If no details are shown it signifies that the nation has not yet notified the tasking authority of its intentions. Page (iv) (and subsequent) gives details of reservations and proprietary rights that have been stated.

FEEDBACK

8. Any comments concerning this publication should be directed to NATO/NSA - Bvd Leopold III, 1110 Brussels - BE.

Enclosure to
AC/310-D/198

STANAG 4526
(Edition 1)
(Ratification Draft 1)

RATIFICATION AND IMPLEMENTATION DETAILS
STADE DE RATIFICATION ET DE MISE EN APPLICATION

NATION / PAYS	NATIONAL RATIFICATION REFERENCE REFERENCE DE LA RATIFICATION NATIONALE	NATIONAL IMPLEMENTING DOCUMENT DOCUMENT NATIONAL DE MISE EN APPLICATION	IMPLEMENTATION/MISE EN APPLICATION					
			INTENDED DATE OF IMPLEMENTATION DATE ENVISAGEE DE MISE EN APPLICATION			DATE IMPLEMENTATION WAS ACHIEVED DATE EFFECTIVE DE MISE EN APPLICATION		
			NAVY MER	ARMY TERRE	AIR	NAVY MER	ARMY TERRE	AIR
BE								
CA								
CZ								
DA								
FR								
GE								
GR								
HU								
IT								
LU								
NL								
NO								
PL								
PO								
SP								
TU								
UK								
US								

Enclosure to
AC/310-D/198

STANAG 4526
(Edition 1)
(Ratification Draft 1)

NAVY/ARMY/AIR

NATO STANDARDIZATION AGREEMENT (STANAG)

SHAPED CHARGE JET, MUNITIONS TEST PROCEDURE

Related documents:

AOP-38	Glossary of Terms and Definitions Concerning the Safety and Suitability for Service of Munitions, Explosives and Related Products.
AOP-39	Guidance on the Development, Assessment and Testing of Insensitive Munitions (MURAT).
STANAG 4396	Sympathetic Reaction, Munition Test Procedures.
STANAG 4439	Policy for Introduction, Assessment and Testing for Insensitive Munitions.

AIM

1. The Aim of this agreement is:

   a. To provide a standard test procedure for determining the degree of reaction, if any, of a munition when hit by a typical top attack bomblet shaped charge jet;

   b. To provide an alternate, tailorable, test procedure for determining the degree of reaction of a munition when hit by a specific shaped charge jet determined by means of a Threat Hazard Assessment.

AGREEMENT

2. Participating nations agree that the procedures incorporated in this STANAG will be used for determining the reaction, if any, of munitions and weapon systems, when impacted by a shaped charge jet, and that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purpose of identification. No departure may be made from the agreement without consultation with the tasking authority. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

DEFINITIONS

3. For the purpose of this document, the definitions of terms used are provided in AOP-38, STANAG 4439, and AOP-39.

GENERAL

4. Minimizing the reaction of ordnance to shape charge jet impact is a continuing commitment of weapons designers in order that the safety of personnel and materiel will not be unduly jeopardised.

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5. This test may not be appropriate for all types of munitions; limitations are given in paragraph 6. Other tests may be required to evaluate the response of munitions in tactical situations, such as when stowed on armored vehicles.

DETAILS OF THE AGREEMENT

6. **Application**. This STANAG provides guidance and procedures for the shape charge test. The test should be conducted by participating nations as a part of the safety evaluation of munitions where required by STANAG 4439, Policy for Introduction, Assessment and Testing for Insensitive Munitions (MURAT). It may also be used for Hazard Classification (HC) and other applications not covered by STANAG 4439, but where the response of a munition to shape charge jet impact is required to be known.

7. **Limitations**. The test is most appropriate for systems containing materials having a detonation failure diameter significantly larger than the jet diameter. Systems containing materials with small failure diameters, including most warheads, will normally fail this test. Consider this when determining whether or not to conduct the test. If other data indicate that the test item is very unlikely to pass the test, do not waste resources by conducting a test whose result is known in advance. The test may also be unnecessary if it can be reliably shown that the detonation failure diameter of the energetic material is larger than the diameter of the munition (so that a detonation cannot be sustained in the munition), and if the threat hazard assessment (THA) indicates that reactions less severe than Type I or Type II (see AOP-38) are not a concern. In order to make this judgement, determine the detonation failure diameter with the energetic material confined as it would be in the real munition. Make such a judgement only for very large and expensive test items, and support such a determination by data on the energetic material that is validated by knowledgeable national authorities. Materiel that passes this test is not necessarily acceptable in a tactical situation. Other tests may be required.

8. **Combination with the Sympathetic Reaction Test (STANAG 4396).** For small and relatively inexpensive munitions, the THA may indicate that the response of one munition by itself is not important, but that the response of a full logistical or tactical package containing several munitions may be important. STANAG 4396 requires that the donor munitions be initiated by the threat most likely to cause detonation. Normally, this will be a shaped charge jet chosen on the basis of the Threat Hazard Assessment, and combining these two tests will be possible. However, if there is another threat that is more likely to cause detonation of the donor, consider a separate Sympathetic Reaction Test.

9. **Standard Test Item**. In the standard test, the item tested must be to the full production standard, although non-explosive sections of the item need only be geometrically and inertially representative. For all-up rounds that contain more than one major energetic component (such as rocket motors and warheads), the energetic components may be tested either individually or as an all-up round. The item may be either packaged or unpackaged as agreed by the appropriate national authorities. If desired, use standard development test items (as opposed to production test items) to allow preliminary assessments. If the test has been combined with the Sympathetic Reaction Test, the test item will normally be one or more logistical packages, but the test may also be performed on an array that represents storage in a tactical vehicle.

10. **Test Configuration**. Figure 1 provides a schematic of a typical test configuration.

11. **Test Requirements**. There are two procedures for performing the Shaped Charge Jet Test. For each procedure, subject the test item, in either its logistical or tactical configuration, or both, as stated in the approved test plan, to a jet from a shaped charge. Include any applicable shielding.

a. Procedure 1 (Standard Test): Using the general guidance, test set-up, and instrumentation specified herein, and in the approved test plan, subject the test item to the jet from a shape charge representing the 50mm Rockeye, or equivalent based on similar V^2d values.

b. Procedure 2 (Tailored Test): Using the general guidance, test set-up, and instrumentation specified herein, and in the approved test plan, subject the test item to the jet from a shape charge based in part on the THA and, in part, on the types of shaped charges that each nation has available for testing.

12. **General Guidance**: In order to facilitate a beneficial exchange of information between nations, some standardization is desirable. In many cases, it has been observed that the effectiveness of a shaped charge in initiating explosive materials is proportional to the square of the jet velocity times the jet diameter (V^2d). Therefore, use a shaped charge jet that produces at least the V^2d value appropriate to the threat, as shown in Table 1, and that gives reproducible performance at the standoff used for this test. The density of the shaped charge jet material also influences the initiation process, so for this test use a copper jet. Ensure the appropriate value of V^2d is achieved on the outside of the munition or its shielding, if shielding is present. To achieve the desired V^2d, it may be necessary to adjust the jet velocity from an available shaped charge by placing an armor plate (conditioning armor) between the shaped charge and the test munition. The conditioning armor is used to adjust the V^2d delivered by the shaped charge. Do not confuse this with shielding, which is part of the munition's normal configuration as determined by the threat hazard assessment. Determine the effect of conditioning armor on jet velocity from equations that are well known to people versed in shaped charge jet technology. If conditioning armor is used, it will produce debris that, in rare instances, may influence the response of the munition. Consequently, if conditioning armor is used, ensure that there is a space of at least two shaped charge cone diameters between the conditioning armor and the test munition to minimize the effect of this debris. However, if the shielding stops the debris, this requirement can be eliminated; and in any case, the thickness of the shielding can be taken as part of this space requirement.

Table 1: Standardized V^2d values for a copper jet.

Threat	Representative V^2D ($mm^3/\mu s^2$)
Top Attack Bomblet	200
50mm Rockeye	360
Rocket Propelled Grenade	430
Anti-Tank Guided Missile	800

13. **Characterization of the Shaped Charge Jet**.

a. Note that two shaped charges which deliver the same V^2d on the outside of a munition or its shielding may deliver VERY different values of V^2d when the jet reaches the energetic material. Consequently, and so all nations may fully understand the test that is conducted, provide a full characterization of the jet if a jet other than the standard 50mm Rockeye is used. Characterization of the jet requires that the following be specified:

- velocity of the leading particle;
- diameter of the leading particle;
- average diameter of the jet particles after particulation;
- breakup time (time from detonation to jet particulation);
- standoff from shaped charge to munition;
- position of the virtual origin of the shaped charge jet within the cone;
- thickness of conditioning armor if any is used;
- penetration capability.

b. It is presumed that nations will have available characterized shaped charge jets that they can use for this test. Characterization of a shaped charge jet requires separate tests that are not described here.

14. **Initiation.** Initiate the shaped charge in a manner that ensures proper formation of the shaped charge jet.

15. **Shotline**. Use judgement in selecting a shotline. Base the shotline on the THA, and in general, select it to produce the greatest possibility of a Type I or Type II reaction while remaining consistent with the THA. In this regard, the following considerations may apply. If the energetic material contains a cavity of significant size, such as the center of a rocket motor, normally aim the jet to pass through this cavity (it has been observed that such cavities can promote the occurrence of Type I reactions). Subject to this constraint, the violence of the reaction, and the chance of getting a Type I response, will normally be maximized by choosing a shot line which gives the longest possible path length in the energetic material. However, generally avoid unlikely shotlines that are aimed at components that are very small compared to the bulk of the explosive or propellant. Therefore, normally do not aim at the igniter.

16. **Shaped Charge Standoff**. Place the shaped charge at a realistic standoff from the munition or its shielding, as determined by the THA. However, note that the standoff influences the V^2d delivered by a shaped charge, so the standoff must be specified as part of the jet characterization. For the sake of reproducibility and comparability of test results, it is best if the standoff is chosen so that the jet does not particulate before reaching the energetic material, but this may not be possible if the shielding is thick.

17. **Instrumentation**. The primary objective of this test is to determine if a Type I or a Type II reaction occurs. The instrumentation used should allow the characterization of any munition reaction in accordance with the reaction descriptors in AOP-38. In the following sub-paragraphs are examples of instrumentation that has proven to be successful in past tests, but the choice of what to use must be made by the test agency with detailed knowledge of the test item.

a. Airblast overpressure. For large munitions, use measurement of the airblast overpressure to provide evidence of the test item reaction. For smaller items, the blast from the shaped charge will obscure the blast from the test item. Install and operate the gauges using experienced personnel. Ideally, calibrate the gauges by deliberately detonating the test munition in its test configuration so that the maximum output from a Type I reaction is known. "Pencil-type" gauges, mounted off-the-ground, are recommended. Recommend using several gauges, mounted at different distances from the test item. The best results are usually obtained when the distance from the event to the gauge is such that the blast overpressure is in the range of 7 to 70 kPa.

b. Ballistic Pendulum. In some circumstances (especially when considering gun propellants in a cartridge case), a ballistic pendulum has proven to be a useful tool for assessing the air blast from jet induced reactions in munitions. Calibrate the pendulum with the detonation of a bare explosive charge and correct for the blast impulse produced by the attacking shaped charge (do not let the jet strike the pendulum).

c. Witness plates. Witness plates are often useful. Use witness plates strong enough to withstand a detonation of the test item. However, the optimum material to use for a witness plate depends on the type and velocity of the expected fragments. For heavy munitions with steel walls, recommend a steel witness plate with a thickness of at least 25 mm. However, for munitions with aluminum skins or very thin steel skins, an aluminum witness plate may work better. For munitions with plastic or composite skins, witness plates may not be useful. Likewise, if shielding is present, witness plates may not be useful, but in some cases, the shielding may function as a witness plate. In some cases, it may be more appropriate to use inert munitions, located where neighboring munitions would be placed in a real logistical or tactical configuration, in the place of witness plates. If witness plates are used, place them adjacent to two sides of the test item and calibrate them by detonating one of the test munitions in the presence of the witness plates. Ensure witness plates are not in contact with the test item since this could alter the response of the test item. Witness plates may affect the air blast from a munition, so it is best if there is no witness plate in the direction of the blast instrumentation.

d. Photography. High-speed motion picture photography may be useful in evaluating the reaction of large items. Recommend test personnel, based on their experience and the circumstances, choose the speed of the photography. Photograph the test setup before and after the test.

e. Wave Velocity Measurements. For very large munitions, it may be useful to measure the propagation rate of the reaction wave in the munition. This can be done with contact shorting pins, piezoelectric pins, or other measurement devices placed just off the surface of the munition at intervals from the point of impact (normally, they would be placed 2 or 3 mm from the surface of the test munition). Normally, it is not advisable to mount such instrumentation internally since this requires alteration of the test item.

f. Response of Adjacent Munitions. If the target consists of multiple munitions, as when this test has been combined with the Sympathetic Reaction Test (STANAG 4396), use the response of the neighboring munitions as a measure of the test result.

g. Fragment Recovery. Recovered fragments can be useful in assessing the type of reaction. In some cases, it may be useful to put up fragment recovery panels (soft fiber board or plaster panels which stop fragments without breaking them). If used, these might replace one of the witness plates. In other cases, when a Type I or Type II reaction does not occur, a map showing the location and type of recovered fragments may be useful.

18. **Documentation**. Develop a data sheet documenting the test results and provide it with the final report.

19. **Observations and records**. As a minimum, the following observations are to be made and reported in the test report :

a. Test item identification (model, serial number, etc.).

b. Type of energetic material and weight.

c. Listing of environmental preconditioning tests performed.

d. A full characterization of the shaped charge jet and conditioning armor, if used, as described in paragraph 13.

e. A record of events versus time through the end of the trial, including indication of propulsion.

f. The nature of any reactions by the test item.

g. Before and after test photos of the test setup and debris.

h. Photographs and description of the witness plates (if used), blast data (if obtained), high speed photography (if used), photographs of the fragments or debris recovered after the test, pin data showing reaction velocity (if obtained), and any other data used to assess reaction violence.

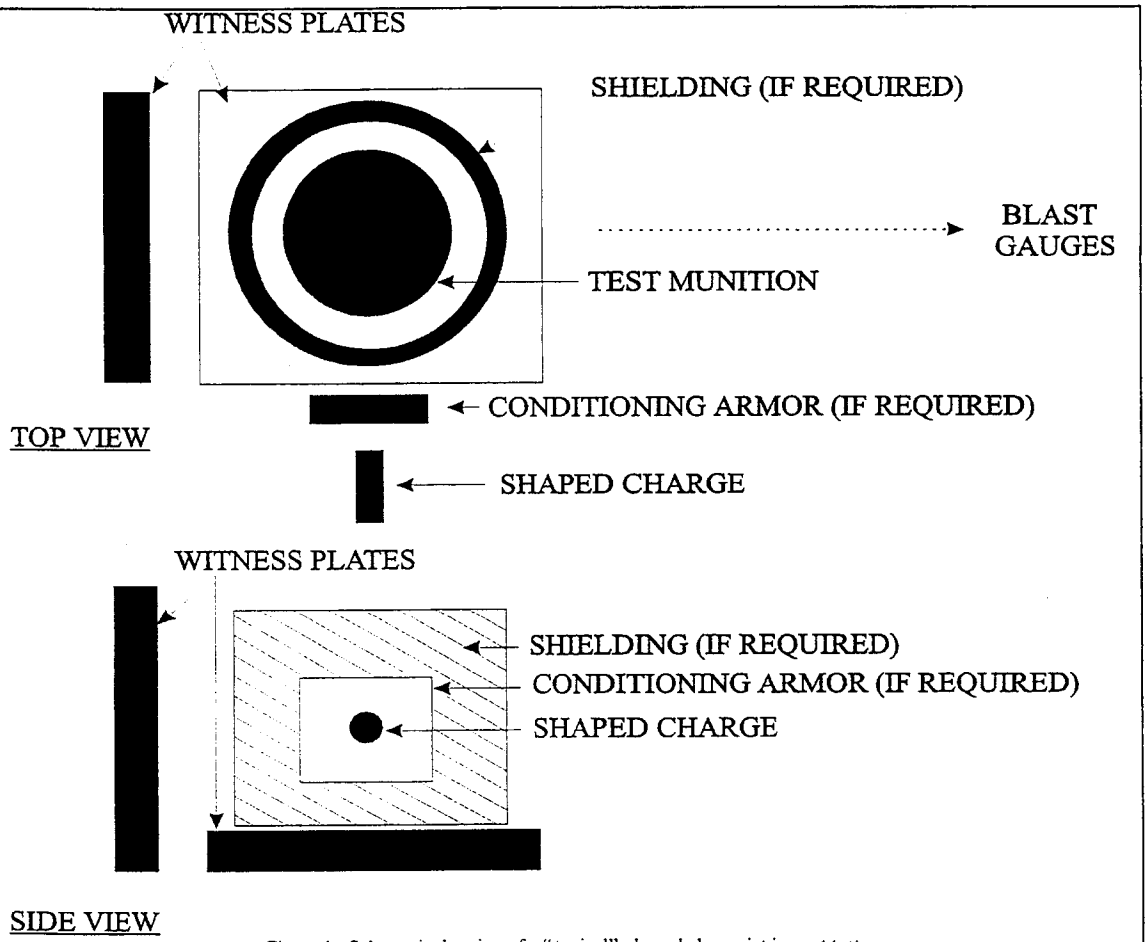

Figure 1. Schematic drawing of a "typical" shaped charge jet impact test.
(Details will vary depending on specific circumstances. The presence of shielding may obviate the usefulness of witness plates.)

IMPLEMENTATION OF THE AGREEMENT

20. This STANAG is considered to be implemented by a nation when that nation has issued the necessary orders/instructions to its forces regarding the use of this agreement for materiel being developed for use by NATO nations,

a. that all future munitions and weapon systems will be assessed/tested in accordance with this agreement,

b. to provide its NATO forces with the details in this agreement with reference to this STANAG.

21. Data developed in accordance with this STANAG shall be made available to other NATO Nations participating in a collaborative weapon development or procurement program, upon receipt of a request submitted through appropriate National channels.